



# Santa Clara Fire Department

## High-Piled Combustible Storage



### PURPOSE

The intent of this guideline is to provide the requirements for the protection of high-piled combustible storage (HPCS) for a variety of commodities. The following requirements will ensure that the minimum measures required by code have been taken to provide for public safety and that the required protection of these commodities has been designed in accordance with Chapter 23 of the 2007 California Fire Code (CFC), Chapter 12 of the 2002 NFPA 13, and other referenced standards.

### SCOPE

This guideline provides the requirements for all HPCS within the City of Santa Clara. For the purposes of this guideline, certain terms are defined as follows:

**Commodity** - A combination of products, packing materials and containers.

**High-Piled Combustible Storage** - The storage of combustible materials in closely packed piles, on pallets, in racks, or on shelves where the top of storage is greater than 12 feet in height. High-piled combustible storage also includes certain high hazard commodities, such as rubber tires, Group A plastics, flammable and combustible liquids, idle pallets, and similar commodities where the top of storage is greater than six feet in height.

**High-Piled Storage Area** - An area within a building that is designated, intended, proposed, or actually used for high-piled combustible storage. For purposes of selecting the applicable fire protection requirement row in Table 2306.2:

- This area shall include the "footprint" of the actual storage array (racks, shelves, fixtures, or pallets), inclusive of aisles within the storage area(s). When individual storage arrays are separated by less than 15 foot spaces, the spaces shall be considered aisles and shall be included in a single storage area footprint. When individual storage arrays are separated by more than 15 foot spaces, the individual arrays shall be considered separate storage areas with their own footprint calculation.
- Each storage area shall also include a 48 inch perimeter aisle calculated in the footprint. This additional perimeter aisle is not required for areas that abut to a wall.
- For multiple storage areas within a building, the aggregate of all high-piled storage areas shall be used for selecting the applicable row in Table 2306.2, unless such areas are separated from each other by a one hour rated fire barrier wall constructed in accordance with Section 706 of the California Building Code (CBC). Openings in such walls shall be protected by fire assemblies having a one hour fire protection rating. CFC 2306.3.2.1.

**Rack Storage** - A combination of vertical, horizontal, and diagonal members that support stored materials. Racks can be fixed or portable.

**Shelf Storage** - Storage on shelves less than 30 inches deep with the distance between shelves not exceeding three feet vertically. For larger shelves and other storage arrangements see Rack Storage.

**Solid Shelving** - Shelving that is solid, slatted, mesh, or grated located within racks that obstructs sprinkler water penetration through the racks.

# SUBMITTAL REQUIREMENTS

## 1. GENERAL:

- A. Plans for HPCS shall be submitted to SCFD for review.
- B. Separate fire permits will be required for installation or modifications of fire alarm or extinguishing systems.
- C. Plans shall be legible, scaled to nationally recognized standards, and blue or black lined.
- D. Submit a completed SCFD Permit Application, which can be obtained at the Fire Marshal's Office which is located at 1675 Lincoln Street, Santa Clara or on the City of Santa Clara website at [www.santaclaraca.gov](http://www.santaclaraca.gov).
- E. Submit appropriate fees: \$715.00.
- F. Contractor requirements specify that a Civil Engineer has to design the structure (racks/shelves), whereas the High-Piled Storage Commodity classification requires that the fire sprinkler layout and design shall be completed by a NICET Level IV Certified Sprinkler Contractor (C-16) or a qualified Fire Protection Engineer (C-16 Specialty).
- G. Submittals may be mailed or hand delivered to Santa Clara Fire Department, Division of Fire Prevention at 1675 Lincoln Street, Santa Clara, CA 95050. All fees must be paid at the time of plan submittal.
- H. Plans not conforming to these minimum requirements will be returned as incomplete.

## 2. PERMIT APPLICATION:

At the time of permit application, plans and specifications, including but not limited to the information listed below, shall be submitted for review and approval. For certain HPCS reviews, the services of a design professional familiar with the requirements contained in CFC Chapter 23 may be of great assistance. A minimum of three sets of plans shall be submitted with the following information per CFC 2301.3:

- A. A letter of intent containing a detailed description of the products to be stored and the description of all containers, pallets, and packaging materials. This letter must also include a detailed description of the storage methods (racks, shelves, pallets), the total storage area in square feet, maximum storage height, and aisle widths. An authorized officer of the company or business must sign this letter. The letter shall be copied onto the plans.
- B. A scaled site plan that shows the entire building, including all fire access lanes, fire hydrants, fire department connection, and fire sprinkler risers.
- C. A scaled floor plan of the building showing locations and dimensions of the HPCS area, location of the racks, and access doors to the storage area.
- D. The maximum desired/proposed storage height for each designated storage area per array. This height is measured from the finished floor to the highest point of the commodity stored (not shelf level).
- E. The number of tiers within each rack.
- F. The commodity clearance between the top of storage and the sprinkler deflector for each storage arrangement.
- G. Aisle dimensions between each storage array. Aisles are measured from the actual edge of the commodity to commodity, not rack to rack.
- H. Maximum pile volume for each storage array.
- I. The location and classification of different commodity classes.
- J. The location of commodities that is banded or encapsulated.

- K. The dimension and location of the transverse and longitudinal flue spaces.
- L. The sprinkler design requirements based on commodity type, aisle width, and sprinkler temperature rating as outlined in 2002 NFPA 13, Chapter 12 (e.g., .45/3000 with 286 degree heads). **A complete sprinkler design shall be submitted under a separate SCFD Fire Permit.**
- M. The location of all steel columns in relationship to the racks. All steel columns located within a rack flue space or immediately adjacent to a rack in an aisle will require protection. See 2002 NFPA 13, Section 12.3.1.7.
- N. The location, make, model, type, and automatic link temperature of the automatic/manual release smoke vents. Fusible links shall be at least one temperature rating higher than the fire sprinklers.

**Note:** New construction shall only use approved/labeled smoke vents as specified by CFC 2306.7. Required smoke vents in existing structures (constructed under the 1998 or previous codes) shall be inspected for proper operation (manual & automatic) and proper link temperature by an independent qualified contractor. Non required existing vents shall be either treated as a required vent or shall have the automatic and manual mechanism deactivated including the removal of the release handles.

An inspection report by the inspecting contractor shall be provided to SCFD prior to plan approval. The report at a minimum shall identify the year the building was constructed, a listing of all vents inspected, the fusible link temperature rating, the presence of a manual release mechanism, and the operational status of each vent. Prior to submitting the report to SCFD, all identified deficiencies must be corrected and included within the report.

If the smoke vents do not contain manual release devices, and SCFD determines that the manual release devices were not specifically required at the time of construction or during any previously approved high piled storage use, then manual release devices will not be required. SCFD staff will evaluate all other conditions on a case by case basis during the review process. If this requirement is placed, SCFD staff will indicate the requirement adjacent to the SCFD approval stamp on the final approved plans from the proposed operation. The vent inspection report shall be copied onto the plans prior to SCFD plan approval.

- O. If required, the design (construction), location, and depth of the curtain board assembly, if applicable.
- P. The occupancy group as defined by CBC Chapter 3.

### 3. **ANNUAL OPERATIONAL PERMIT – CFC 2301.2**

An annual operational permit is required when a building or portion thereof is used for high-piled storage exceeding 500 square feet in area (see the definition of high-piled storage area under “Scope”). Annual operational permit fees are invoiced annually with the business license. CFC 2301.2.

### 4. **COMMODITY CLASSIFICATION - CFC 2303**

Commodities shall be classified as Class I, II, III, IV, or High Hazard, in accordance with CFC Chapter 23.

Plastics shall be classified as Group A, B, or C in accordance with CFC Chapter 23. To determine the proper commodity classification of products with limited quantities of Group A plastics in mixed commodities, use CFC Figure 2303.7.4. This figure identifies the quantity of Group A plastics allowed to be stored in a package, carton, or on a pallet without increasing the hazard and commodity classification to “high hazard.”

The designation and protection features of a high-piled combustible storage area intended for storage of different commodity classes shall be based on the highest hazard commodity stored, except as otherwise provided for by engineering analysis in CFC 2304.2.

### 5. **GENERAL FIRE PROTECTION PROVISIONS - CFC 2306**

Fire protection features for high-piled storage areas shall be in accordance with CFC Chapter 23 and other nationally recognized standards approved by the SCFD. Fire detection systems, smoke and heat removal, curtain boards, and fire sprinkler design densities shall extend to 15 feet beyond the high-piled

storage area or to a permanent partition, whichever is least. The aggregate of all high-piled storage areas within a building shall be used to design the fire protection features found in CFC Table 2306.2 (attached), unless such areas are separated from each other by a one hour fire barrier wall constructed in accordance with CBC 706. Distinct occupancy groups shall be separated according to CBC 508.

**6. FIRE SPRINKLER SYSTEMS - CFC 2306.4**

When fire sprinklers are required by CFC Table 2306.2 or the CBC (or if otherwise provided), the sprinkler system shall be installed in accordance with 2002 NFPA 13.

**7. FIRE DETECTION SYSTEMS - CFC 2306.5**

When fire detection is required by CFC Table 2306.2, an approved automatic fire detection system shall be installed in accordance with 2002 NFPA 72 standard throughout the high-piled storage area. This system shall be installed and monitored as required by CFC 907.

**8. FIRE DEPARTMENT ACCESS - CFC 2306.6**

When building access is required by CFC Table 2306.2, access roadways shall be provided to within 150 feet of all portions of the exterior walls of the building used for high-piled storage. When access doors are required by CFC Table 2306.2, they shall be provided in each 100 lineal feet of exterior wall and shall face the required access roadway.

**9. SMOKE AND HEAT REMOVAL - CFC 2306.7**

When smoke and heat removal are required by CFC Table 2306.2, smoke and heat vents shall be of an approved type and shall operate automatically by a heat response device rated between 100°F and 200°F above ambient temperatures and contain a manual release roof handle. Vent size shall be in accordance with CFC Table Section 910 (attached.) The fusible link temperature is required to be at least one temperature rating greater than that of the fire sprinkler head at the roof to prevent early venting.

Smoke and heat vents are *not* required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with 2002 NFPA 13.

For existing conditions refer to Section 2 N of this document.

**10. CURTAIN BOARDS**

When required by CFC Table 2306.2, curtain boards shall be installed in accordance with CFC 910.3.5.

**11. RACK FLUE SPACES - CFC 2308.3**

Requirements for flue spaces within the rack storage are provided in CFC Table 2308.3 (attached). Double row racks shall be equipped with a pallet/commodity stop along the longitudinal flue space at each level. The stop shall be steel or other ferrous material ¼" thick and in the mounted position shall extend a minimum of 4 inches above the shelf or cross member, or other method approved by the fire code official (CFC 2308.3).

**12. CONTROL OF IGNITION SOURCES**

Smoking shall be prohibited in the warehouse storage area. "NO SMOKING" signs shall be conspicuously posted. Clearance between ignition sources and the combustible storage shall be maintained in accordance with CFC 305 and 310.

**13. SOLID PILED AND SHELF STORAGE**

Shelf storage, storage in solid piles, solid piles on pallets, and storage in bin boxes not exceeding five feet in any dimension shall be in accordance with CFC 2306 and 2307.

**14. RACK STORAGE**

Rack storage shall be in accordance with CFC 2306 and 2308. Racks with solid shelving having an area greater than 32 square feet measured between approved flue spaces at all four edges of the shelf shall be in accordance with CFC 2308.2.2.

**15. AUTOMATED STORAGE**

Automated storage similar to carousel storage shall be in accordance with CFC 2309.

## 16. SPECIALTY STORAGE - CFC 2310

Record storage facilities used for rack or shelf storage of combustible paper records greater than 12 feet in height shall be in accordance with CFC 2306 2308, and NFPA 13 and NFPA 230. Palletized storage of records shall be in accordance with CFC 2307.

## 17. MAINTENANCE - CFC Chapter 9

All fire and life safety equipment and systems required by the CFC shall be maintained operable at all times. Equipment, devices, and systems shall be regularly tested in accordance with nationally recognized standards, manufacturers' recommendations, and adopted regulations.

## 18. TECHNICAL ASSISTANCE

Due to the complexity of the designs specified within the CFC and adopted standards, it may be necessary to obtain the service of a fire protection design professional to assist with developing a protection scheme that meets the requirements of the CFC and other applicable regulations.

**TABLE 910.3 REQUIREMENTS FOR DRAFT CURTAINS AND SMOKE AND HEAT VENTS<sup>a</sup>**

OCCUPANCY GROUP AND COMMODITY CLASSIFICATION	DESIGNATED STORAGE HEIGHT (feet)	MINIMUM DRAFT CURTAIN DEPTH (feet)	MAXIMUM AREA FORMED BY DRAFT CURTAINS (square feet)	VENT-AREA-TO FLOOR-AREA RATIO <sup>c</sup>	MAXIMUM SPACING OF VENT CENTERS (feet)	MAXIMUM DISTANCE TO VENTS FROM WALL OR DRAFT CURTAINS <sup>b</sup>
Group F-1 and S-1	--	0.2xH <sup>d</sup> but ≥ 4	50,000	1:100	120	60
High-piled storage (see Section 910.2.2) I-IV (Option 1)	≤ 20	6	10,000	1:100	100	60
	>20≤40	6	8,000	1:75	100	55
High-piled storage (see Section 910.2.2) I-IV (Option 2)	≤ 20	4	3,000	1:75	100	55
	>20≤40	4	3,000	1:50	100	50
High-piled storage (see Section 910.2.2) High-hazard (Option 1)	≤ 20	6	6,000	1:50	100	50
	>20≤30	6	6,000	1:40	90	45
High-piled storage (see Section 910.2.2) High-hazard (Option 2)	≤ 20	4	4,000	1:50	100	50
	>20≤30	4	2,000	1:30	75	40

For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m<sup>2</sup>.

- Requirements for rack storage heights in excess of those indicated shall be in accordance with Chapter 23. For solid-piled storage heights in excess of those indicated, an approved engineered design shall be used.
- The distance specified is the maximum distance from any vent in a particular draft curtained area to walls or draft curtains which form the perimeter of the draft curtained area.
- Where draft curtains are not required, the vent area to floor area ratio shall be calculated based on a minimum draft curtain depth of 6 feet (Option 1).
- "H" is the height of the vent, in feet, above the floor.

**TABLE 2306.2: GENERAL FIRE-PROTECTION AND LIFE SAFETY REQUIREMENTS**

Commodity Class	Size of High-Piled Storage Area <sup>a</sup> (square feet)(See Sections 2306.2 and 2306.4)	ALL STORAGE AREAS (See Sections 2306, 2307 and 2308)					SOLID-PILED STORAGE, SHELF STORAGE AND PALLETIZED STORAGE (See Section 2307.3)		
		Automatic Fire-Extinguishing (See Section 2306.4)	Fire-Detection System (See Section 2306.5)	Building Access (See Section 2306.6)	Smoke and Heat Removal (See Section 2306.7)	Draft Curtains (See Section 2306.7)	Maximum Pile Dimension <sup>c</sup>	Maximum Permissible storage height <sup>d</sup> (feet)	Maximum pile volume (cubic feet)
I-IV	0-500	Not Required <sup>a</sup>	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	Not Required	Not Required	Not Required
	501-2,500	Not Required <sup>a</sup>	Yes	Not Required <sup>e</sup>	Not Required	Not Required	100	40	100,000
	2,501-12,000 Public Accessible	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	100	40	400,000
	2,501-12,000 Nonpublic Accessible (Option 1)	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	100	40	400,000
	2,501-12,000 Nonpublic Accessible (Option 2)	Not Required <sup>a</sup>	Yes	Yes	Yes <sup>j</sup>	Yes <sup>j</sup>	100	30 <sup>f</sup>	200,000
	12,001 - 20,000	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	100	40	400,000
	20,001 – 500,000	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	100	40	400,000
	500,000+ <sup>g</sup>	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	100	40	400,000
High-hazard	0-500	Not Required <sup>a</sup>	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	50	Not Required	Not Required
	501-2,500 Public Accessible	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	50	30	75,000
	501-2,500 Nonpublic Accessible (Option 1)	Yes	Not Required	Not Required <sup>e</sup>	Not Required	Not Required	50	30	75,000
	501-2,500 Nonpublic Accessible (Option 2)	Not Required <sup>a</sup>	Yes	Yes	Yes <sup>j</sup>	Yes <sup>j</sup>	50	20	50,000
	2,501-300,000	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	50	30	75,000
	300,001-500,000 <sup>g,h</sup>	Yes	Not Required	Yes	Yes <sup>j</sup>	Not Required	50	30	75,000

For SI: 1 foot = 304.8 mm, 1 cubic foot = 0.02832 m<sup>3</sup>, 1 square foot = 0.0929 m<sup>2</sup>.

- When automatic sprinklers are required for reasons other than those in Chapter 23, the portion of the sprinkler system protecting the high-piles storage area shall be designed and installed in accordance with section 2307 and 2308.
- For aisles, see Section 2306.9.
- piles shall be separated by aisles complying with section 2306.9.
- Fore storage in excess of the height indicated, special fire protection shall be provided in accordance with note g when required by the fire code official. See also Chapter 28 and 34 for special limitations for aerosols and flammable and combustible liquids, respectively.
- Section 503 shall apply for all fire apparatus access.
- For storage exceeding 30 feet in height, Option 1 shall be used.
- Special fire protection provisions including, but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional fire department hose connections shall be provided when required by the fire code officials.
- high-piled storage areas shall not exceed 500,000 square feet. A 2-hour fire wall constructed in accordance with the *California Building Code* shall be used to divide high-piled storage exceeding 500,000 square feet in area.
- Not required when an automatic fire-extinguishing system is designed and installed to protect the high-piled storage area in accordance with Section 2307 and 2308.
- Not required when storage areas are protected by early suppression fast response (ESFR) sprinkler systems installed in accordance with NFPA 13.

**Table 2308.3: REQUIRED FLUE SPACES FOR RACK STORAGE**

RACK CONFIGURATION	FIRE SPRINKLER PROTECTION Storage Height		SPRINKLER AT THE CEILING WITH OR WITHOUT MINIMUM IN-RACK SPRINKLERS			IN-RACK SPRINKLERS AT EVERY TIER	NON- SPRINKLERED
			≤ 25 feet		> 25 feet	Any Height	Any Height
			Option 1	Option 2			
Single-row rack	Transverse flue space	Size <sup>b</sup>	3 inch	NA	3 inch	NR	NR
		Vertically aligned	NR	NA	Yes	NA	
	Longitudinal flue space		NR	NA	NR	NR	
Double-row rack	Transverse flue space	Size <sup>b</sup>	6 inches <sup>a</sup>	3 inch	3 inch	NR	
		Vertically aligned	NR	NR	Yes	NA	
	Longitudinal flue space		NR	6 inch	6 inch	NR	
Multi-row rack	Transverse flue space	Size <sup>b</sup>	6 inches	NA	6 inch	NR	
		Vertically aligned	NR	NA	Yes	NA	
	Longitudinal flue space		NR	NA	NR	NR	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Three inch transverse flue spaces shall be provided at least every 10 feet where ESFR sprinkler protection is provided.

b. Random variations are allowed, provided that the configuration does not obstruct water penetration.

## HIGH-PILED STORAGE CHECKLIST

Prior to the permit review process an overview of the HPCS permit submittal package will be conducted. Any Items found missing will be required to be submitted prior to the start of the permit review process. In order to ensure a an efficient and effective review of you permit submittals, all items shall be submitted at the time of application.

Included	Design drawings shall include the following items on the existing and proposed storage arrangements as detailed out in "II. A." mentioned above.
1	Site plan that identifies the project building, adjoining lots and buildings, building openings, etc.
2	Scaled architectural floor plan of the building showing locations and dimensions of the HPCS areas.
3	A letter of intent containing a detailed description of; the products to be stored, all containers, etc.
4	Analysis of how the commodity classification was determined.
5	Evacuation Plan - a separate set of plans, which dictates an evacuation plan for the HPCS area and building.
7	The maximum desired/proposed storage height for each designated storage area.
8	A drawing detail showing the tiers and dimensions of all of the storage methods used.
9	Clearance between top of storage and the roof/ceiling height for each storage method.
11	On a scaled floor plan, show the aisle dimensions between each storage area.
12	On a scaled floor plan, show the maximum pile volume for each storage area.
13	On a scaled floor plan, show the location of commodities, which are banded or encapsulated.
14	A drawing detail showing the dimensions and location of transverse and longitudinal flue spaces.
15	Detail the type, location and specifications of smoke-removal vents.
16	If required, the design (construction), location, and depth of the curtain board assembly.
17	Denote whether or not the "Arrays" are closed or open for each storage arrangement.
18	Identify all contiguous areas occupied by a limited higher-hazard commodity.
19	Locations and classifications of the portable fire extinguishers.
20	Identify the location of all steel columns in relationship to the racks and detail how they are protected.
23	If applicable, provide complete details on the location of all initiating and notification devices..
24	Type of pallets, including materials of construction.
25	Type of shelf that will be used for each shelf/rack system.
26	Details on any specialty storage arrangement systems.
<b>Fire Sprinkler Permit</b>	
	In an effort to ensure that both the HPCS and associated Fire Sprinkler permits are reviewed in an effective and efficient manner the fire sprinkler permit should be submitted with the HPCS permit. The following information must be included with the submittal for the fire sprinkler permit:
1	Water flow test data in close proximity to the site (that was performed within the last 5 years).
2	Sprinkler system design approach based upon commodity type, rack type, aisle width, sprinkler temp. etc. with determining code sections, tables, figures and curves.
3	Hydraulic calculations for ceiling and storage rack sprinklers.
4	Identify how the sprinkler design density extends 15-feet beyond the high-piled storage areas.
5	Make, type, model, nominal K-factor, temperature rating and specifications (cut sheet) for each sprinkler type.
6	Scaled floor plan showing the location of control valves.
7	Scaled floor plan showing location(s) and a details of any Class I standpipe systems.
8	Scaled floor plan showing the location of face sprinklers from the aisle face of storage.
9	Scaled floor plan showing the location of all listed hangers and flex couplings, including a detail of each type of vertical drop.
10	Scaled floor plan showing the locations of all sway bracing.
11	Description of horizontal barriers used in conjunction with in-rack sprinklers.
12	Elevation drawing showing vertical clear space between the top of storage and in-rack sprinkler deflectors.
13	Elevation drawing showing the in-rack sprinkler locations in relationship to flues and storage.